April 6, 1987

J. David Dunn
Director, Business Development
Standard Oil Engineered Materials Company
P. O. Box 156
Niagara Falls, New York 14302

RECEIVED
APR 9 1987
J.D. DUNN

Dear Mr. Dunn,

I enjoyed meeting with you on April 1, 1987 and extend a belated thanks for the lunch. I trust the rest of your trip was successful and you returned home safely.

I have instructed my attorney to cooperate with your representative as we discussed and am sure that the information to be provided will be of significant interest to him.

During our meeting you expressed surprise at my statement regarding submittal of a proposal to Standard Oil covering the development of a system for measuring "Crop Water Stress" by Telatemp Corporation. I am enclosing a copy of the proposal dated April 10, 1984. The request for such a proposal was made by Bronson Gardner and Mel Keener.
I am sure you would agree that this was some time before Standard Oil decided to produce such a system. The proposal offers a system quite similar to the package you are currently marketing. I trust that you will now understand my comments regarding my concern for working with your engineering representative during his subsequent visit to our plant.

I briefly reviewed the MIRC report you provided and feel that it does not describe the IR market or the players accurately. If I had ordered a copy , I would have demanded my money back. It looked like an amateur had prepared it with inadequate data. I certainly wouldn't base any marketing decisions on it.

I have firmed up my plans for my trip the week of April 10, 1987 and expect to be availabe for our suggested meeting after 2 PM, April 13,1987. I do not have confirmed hotel reservations in Toronto at present but will call your office to make final arrangements for our meeting after my plans are completely firm. I am scheduling a flight from Buffalo to NYC after 2 PM April 14, 1987 leaving the AM open for discussion with you.

Sincerely,

R.E.Darringer, President

Telatemp Corp
INFRARED THERMOMETRY

P.O. BOX 5160, FULLERTON, CALIFORNIA 92635 · (714) 879-2901

April 10, 1984

BRONSON GARDNER
Standard Oil Company (OHIO)
3092 Broadway Avenue
Cleveland, Ohio 44115

Subject: TELATEMP IR MOISTURE SENSING SYSTEM

Dear Mr. Gardner:

The enclosed proposal is submitted in response to your request. It is apparent that Standard Oil and Telatemp are thinking along parallel paths with regard to the future needs of the grower relative to agricultural irrigation and water conservation.

Telatemp Corporation has developed and is currently producing hand-held Infrared Thermometers in accordance with the stringent requirements of the USDA. We were awarded a development contract in 1977 which required accuracy, stability and ruggedness unheard of previously, except in units costing 4 to 5 times more and yet lacking needed portability.

Our Model AG-42 is now considered a necessary research tool by any agronomist interested in studying the relationship between crop canopy temperatures, crop yield and irrigation scheduling. Every major agriculture-oriented college, university or government/private research facility throughout the U.S. and the world is using the AG-42 to further advance their studies. Recently, we have been discussing the use of the same instrument to provide data for investigating the optimum time to apply various nutrients, chemicals, and weed controls during irrigation cycles.

This proposal is a result of many meetings with agronomists from several different growing areas and incorporates their recommendations as to what will be needed by the profit-oriented grower; specifically, applying the "Crop Water Stress Index" theory to future land management programs.

Continued...

telatemp corp
SURFACE THERMOMETRY
P.O. BOX 5160, FULLERTON, CALIFORNIA 92635 · (714) 879-2901

It is conceivable that a possible association between our respective companies will place us on the leading edge of what we strongly believe to be the future answer to irrigation management. Telatemp Corporation is dedicated to transferring the use of Infrared technology from the research agronomist to the enlightened grower as a means of "**maximizing profits.**"

We are extremely pleased that Standard Oil has the foresight and possible interest in pursuing this new and exciting opportunity with us.

Sincerely,
TELATEMP CORPORATION

R. E. Darringer
President

RED/nlh

enclosures

HISTORY

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INCORPORATED:	December 31, 1971
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OFFICERS:	R. E. Darringer, President/Treasurer E. L. Darringer, Vice President/Secretary
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PRODUCT DISTRIBUTION:	Worldwide representation and factory direct sales
MARKET SEGMENTS:	Industrial, electronics, agriculture and medical
GROSS SALES:	In excess of 1/2 million dollars
PRODUCTS:	a.) Telatemp Temperature Recorders b.) Temperature Indicating Paints c.) Temperature Indicating Crayons d.) Cholesteric Liquid Crystal Contact Thermometers e.) Critical Temperature Indicators f.) Infrared Thermometers
Note:	a, d, e & f can be custom designed to meet specific customer needs.
TECHNICAL EXPERTISE:	CHEMICAL Development of temperature indicating devices utilizing various chemicals and coating techniques
	ENGINEERING Development of infrared temperature measuring systems including all electronics, optics and mechanical hardware
	AGRONOMY Study of uses for Infrared Thermometry and associated equipment related to irrigation scheduling - field evaluation - determining future requirements

TELATEMP INFRARED MOISTURE SENSING SYSTEM

P R O P O S A L

April 10, 1984

TELATEMP CORPORATION
Fullerton, California

telatemp corp
SURFACE THERMOMETRY

P.O. BOX 5160, FULLERTON, CALIFORNIA 92635 · (714) 879-2901

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P R O P O S A L

I. Introduction

In this proposal, Telatemp Corporation presents a plan for developing a portable instrumentation device capable of measuring Crop Water Stress Index (CWSI). The readings obtained with this device will be compared against a data base maintained within the unit to determine if the crop being measured requires irrigation.

The effort included in this proposal consists of determining the parameters to be measured, determining the required accuracy of the parameters, specifying the transducers, designing the signal conditioning, designing the computing circuit, designing the mechanical assembly and packaging, defining the algorithm for computation of CWSI, designing the software for the microprocessor, and building 2 prototype units for evaluation.

II. Historical Background

Plant temperature has long been recognized as an indicator of water availability (Gates, 1964; Wiegand and Namken, 1966). Until infrared thermometers became available, most plant temperature measurements were made with contact sensors on, or embedded in, leaves (e.g., Ehrler, 1973). Monteith and Szeicz (1962) and Tanner (1963) stated that 'plant temperature may be a valuable qualitative index to differences in plant water regimes.' During the past decade, infrared technology has progressed to the point that lightweight (approx. 1 kg) hand-held infrared thermometers, accurate to 0.5°C, are available for routine use. The rapidity of measurement and the ability to average the temperature of all plant parts within the field of view (FOV) of the instrument make these devices ideal for crop canopy temperature measurements.

Ehrler (1973) used thermocouples embedded in cotton leaves to determine leaf temperatures. His results showed that the leaf-air temperature differences decreased after irrigation, reached a minimum several days later, and then increased as the soil water became limiting. His data indicated that a linear relationship exists between the leaf-air temperature difference and the vapor pressure deficit of the air. He concluded that using leaf-air temperature differences for scheduling irrigations in cotton has merit and should be developed.

Idso et al. (1977) and Jackson et al. (1977) used the canopy temperature T_c (as measured by infrared thermometry) minus the air temperature T_a as an index of crop water status. They called the difference $T_c - T_a$ the 'stress-degree-day' and related this parameter to yield and water requirements.

The stress-degree-day concept of crop water stress assessment and yield prediction has proven to be of considerable utlity (Idso et al., 1977, 1978a; Jackson et al., 1977; Walker and Hatfield, 1979). Briefly, it posits that if a crop is well supplied with water, transpiration will be at the potential rate and the crop will be relatively cool. When a certain fraction of the available soil moisture (dependent on environmental conditions) has been extracted from the root zone, however, transpiration will be reduced from potential and the crop will increase in temperature. At this stage, or sometime thereafter, the crop may also experience a reduction in photosynthesis that can lead to an ultimate decrease in final yield.

*See note Page 6

Because Idso et al. and Jackson et al. were concerned with developing a technique to evaluate crop water stress remotely (with a minimum number of measurements), they assumed that environmental factors such as vapor pressure deficit, net radiation, and wind would be largely manifested in the temperature difference. Experience has shown that this assumption is not too restricting in some cases but is severely restricting in others. Recently, Idso et al. (1981a) presented $T_c - T_a$ and vapor pressure deficit (VPD) data for several crops and showed that the relationship between $T_c - T_a$ and VPD, for well-watered crops under clear sky conditions, was linear, as Ehrler (1973) has suggested. They used a line obtained by linear regression on these data as a lower limit, and an upper limit assumed to hold for non-transpiring crops, to define a Crop Water Stress Index (CWSI). They suggest that this index is a reasonably quantitative evaluator of crop water stress and, in situations where vapor pressure deficit data are available, should be used in place of the stress-degree-day.

Currently, infrared thermometry provides a quantitative measure of plant stress which can be incorporated into real-time applications. Surveys have shown that irrigation scheduling is an economically viable procedure which would benefit the agricultural community, however, there is a need for an easy method of assessing irrigation requirement.

The concept of using infrared thermometer measurements of canopy temperature incorporates other meteorological variables in the calculation of a Crop Water Stress Index. The current algorithms involve a measure of canopy temperature, vapor pressure deficit and one approach developed by Jackson et al. (1981) incorporates net radiation. The approach by Idso et al. (1981) uses a concept of an upper and lower baseline calculated from empirically developed relationships between canopy-air temperature differences and vapor pressure differences. O'Toole and Hatfield (1982) have found that the upper baseline is dependent upon windspeed and the correction could be easily made with this additional parameter.

Hatfield (1981, 1982) has found that the approach suggested by Idso et al. (1981) could be utilized to accurately assess the irrigation requirements in grain sorghum for three different years. The form of this relationship was an exponential form between the Plant Water Stress Index and the available water in the soil profile. The significance of this study is found in the fact that the relationship was developed over a range of rooting depths ranging from 50 to 300 cm. This would suggest that a common algorithm could

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exist for a particular crop. Idso (1982) has developed these empirical baselines for a number of crops, however, the relationship between the Plant Water Stress Index and soil water extraction is yet to be tested. To date there has been no comprehensive comparison of the Idso or Jackson methods, but the algorithms proposed appear to be very sound and useful for assessing irrigation requirements. The procedure outlined by Hatfield would suggest that once the extraction begins, the pattern will follow a given curve which would benefit any scheduling operation because it would allow for planning of field operations.

Hatfield et al. (1982) found in studies of intensive sampling that the number of samples required to adequately represent a field was dependent on the soil moisture extraction. If the soil profile had more than 60% available moisture only 10 samples were needed to estimate the field mean within a 1.0°C confidence limit. This would indicate the number of samples needed for evaluating a field are reasonable and feasible. It is Hatfield's opinion that only one measurement of the ancillary meteorological data is required for the evaluation of the Crop Water Stress Indices. However, it is our contention that multiple meteorological readings at the site of the CWSI determinations may be conducive to reducing the data scatter which has been mentioned in the cited studies.

Note: Full description of technical papers available upon request.

III. Function of Proposed Unit

The function of the proposed unit will be to acquire data for the parameters necessary for the computation of Crop Water Stress Index to the degree of accuracy necessary to implement an irrigation management system based on crop water stress.

At the present time, agronomists have established:

1. That there exists a characteristic curve relating foliage-air temperature differential to air vapor pressure deficit for each crop when well-watered.

2. That when the foliage-air temperature vs. air vapor pressure deficit measurement exceeds the characteristic curve by a specified amount the crop needs irrigation.

3. That the amount by which the measurement can exceed the characteristic curve without reducing crop yield is dependent on the crop and the crop maturity.

4. That the yield of certain crops may be increased by inducing specified levels of stress at the appropriate time(s) in the growth cycle.

With the above points in mind, the proposed unit will have provisions for storing the characteristic curves for various crops in plug-in memory modules. In addition, allowable CWSI numbers for each day of maturity for each crop will be included in the plug-in where this data is available. An integral real time clock-calendar will allow the proposed unit to compare the condition of the crop to the theoretically ideal conditions for the same crop of the same maturity and indicate whether to withhold irrigation or to water. By using plug-in memory modules, the data base may be expanded as information becomes available.

Although the proposed unit is intended to be an indicator of Crop Water Stress Index, provisions will be included to allow the recording of data so that the user that is so inclined may develop his own data base. This will be accomplished by displaying the CWSI as measurements are being taken, and by holding the raw data from all measurements in an internal memory which can be dumped into a computer for processing.

IV. Configuration of Proposed Unit

The proposed unit will consist of two assemblies: The gun, which is hand-held; and the electronics package, which is carried with a shoulder strap, or in a back pack if necessary.

The gun will contain the IR sensor with its standardizing circuitry, plus possibly the sensors for ambient temperature and relative humidity.

The electronics package will contain the power pack and charger, the signal conditioning circuits, microprocessor, memory, look-up tables, and RS 232 interface circuitry. The electronics package will also contain a telescoping support for a wind speed sensor.

Design of both items will be such that manual input of data is not required for acquisition unless specifically enabled by the user.

Data output will consist of a liquid crystal display in the gun which will display all of the measured parameters plus foliage-air temperature differential, air vapor pressure deficit and Crop Water Stress Index. In addition, the display will indicate irrigation required or no irrigation required.

V. Design Philosophy

The design of the proposed unit is based on the following premises:

1. Rugged enough to withstand field use without damage. Not built to the stringent requirements of military products, but stronger than commercial products. Construction techniques would match industrial grade equipment.

2. Completely self-contained. All transducers, conditioning circuits, battery supplies, chargers, computer components and solid state memory are included in the unit.

3. Computer compatible. RS 232 interface included in the unit. Interacts with any manufacturer's computer.

4. Fool-proof operation. Operator pulls trigger to obtain data. No need to input any information (unless specifically desired by customer). Field identification can be programmed by a key. Each field will have an assigned unique key to eliminate data entry error.

5. Universal application. Field identification selects data base appropriate to crop.

6. Readily portable. A single small case with shoulder strap carries all electronics and power. A hand-held gun with trigger possibly to contain all transducers except wind speed.

7. Modular design. Readily interchangeable modules allow for easy field service anywhere in the world.

8. Technical support. In addition to complete hardware and software service training information, new data base memory modules will be produced as the support information becomes available.

9. Future application. During the design of the portable unit, it will be kept in mind that operation as a fixed head system such as center pivot irrigation may be desirable in the future. Every effort will be made to allow components to be used for both applications. Likewise, sufficient power will be incorporated into the microprocessor unit so that if future investigation shows the need for measuring additional parameters or performing additional computations, the changes can be made to the existing design with a minimum of effort.

VI. Design Tasks

The Telatemp Model AG-42 will be used as the basis of design for the IR portion of this unit. It is a research tool, and as such, meets very stringent specifications which may not be necessary as a part of a complete sensing system.

The proposed gun will be operating in conjunction with temperature, relative humidity, and wind speed sensors which are less accurate than the AG-42. One of the tasks of the proposed design effort will be to establish the specification requirements of each of the system components so that optimum performance vs. cost can be obtained. Could require system computer model analysis.

The tasks to be performed under this proposal will include the following:

1. Evaluate latest theoretical data in order to define parameters that need to be measured.

2. Establish the minimum allowable accuracy for each parameter necessary to obtain an adequate Crop Water Stress Index number.

3. Simplify the AG-42 design to meet required specifications.

4. Determine the availability of a suitable relative humidity detector. Make a buy or build decision.

5. Determine the availability of a suitable wind-speed detector. Make a buy or build decision.

6. Design signal conditioning circuits appropriate to the transducers selected.

7. Design microprocessor circuit appropriate to the application.

8 Determine power requirements. Design power system suitable for 1 day operation with overnight charge.

9. Design mechanical assembly and packaging.

10. Define algorithm for computation of Crop Water Stress Index and design software for microprocessor.

11. Build 2 prototype units and evaluate performance.

12. Refine design. Build additional prototypes if required.

TELATEMP INFRARED MOISTURE SENSING SYSTEM

P R O P O S A L

April 10, 1984

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Fullerton, California

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5. Determine the availability of a suitable wind-speed detector. Make a buy or build decision.

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11. Build 2 prototype units and evaluate performance.

12. Refine design. Build additional prototypes if required.

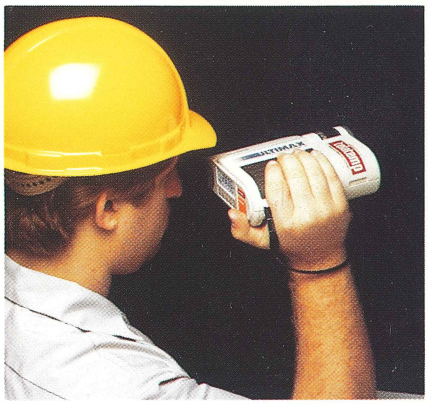
telatemp TTL Viewing Infrared Thermometers

Instant non-contact digital surface temperature measurements with precise TTL (through-the-lens) focusing and sighting

ULTIMAX HUMAN-ENGINEERED INFRARED THERMOMETERS

Operator's view through viewfinder showing spot size reticle and internal digital LCD temperature display

- **Precision spot size TTL viewing**
- **Focusable optics improves accuracy**
- **A choice of ten models for a variety of non-contact applications**



The Ultimax™ human-engineered rear panel puts the ultimate in ease-of-use in the palm your hand . . .

LARGE LCD DISPLAY is visible in both bright and low light levels. It features four-digit temperature readings plus a self-diagnostics monitor for low battery indication, case temperature alarm, internal circuit check and LCD display check.

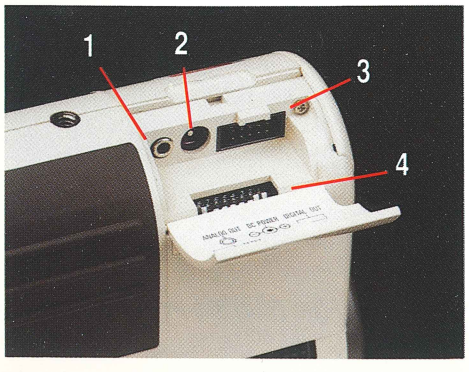
THROUGH THE LENS VIEWFINDER allows precise lens focusing at varying distances and reticle-defined spot size of the exact target area being measured. Operator views LCD temperature display.

SET UP MODE SELECTION SWITCHES include Emissivity Adjust, Response Time Constant and Mode Selection set-up for peak, delay, valley and real measurements.

ON/OFF AND MEASURE switches are large and have a positive feel for ease of operation.

The Ultimax hand-held infrared thermometer has many advantages over contact measurements. By measuring the amount of infrared energy emitted from a solid object, the instrument can instantly display a digital readout of a surface without contact. Easy-to-hold and use, this sophisticated instrument has the feel of a fine SLR camera. Simply aim, focus and push MEASURE for an instant digital readout. The Ultimax through-the-lens focusing and target sighting with reticle-defined spot size produces more accurate measurements.

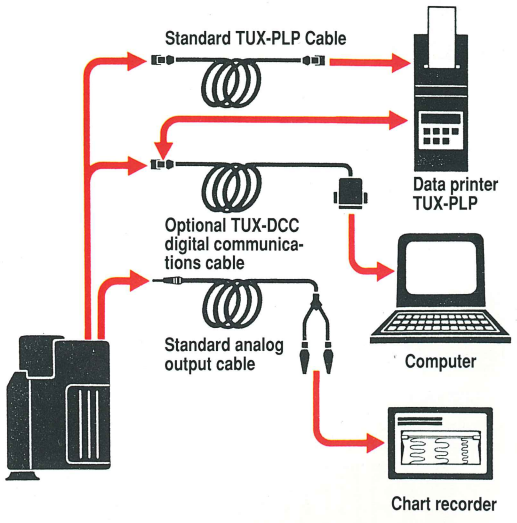
Standard Input/Output Interfaces



HIDDEN COMPARTMENT WITH REMOVABLE COVER HOLDS CONNECTIONS

1. Linearized analog temperature output, 0-1Vdc over selected span for chart recorders
2. DC power jack for optional external AC adapter
3. RS-232C digital port for interface with Ultimax datalogger/printer, computers and controllers
4. DIP switch internal functions including °F/°C (factory preset to °F), baud rates, communications protocols and other operating parameters.

The ultimate portable data acquisition system for plant engineering, processing, quality assurance



telatemp TTL Viewing Infrared Thermometers

ULTIMAX THERMOMETER SPECIFICATIONS

Each instrument comes in an attache-type carrying case, complete with wrist strap, digital (RS-232C) and analog outputs, analog output cable, tripod mounting adapter, 4 AA Alkaline batteries and an operations manual. See optional Datalogger/Printer below.

Ambient Operating Temperature	32°F to 125°F (0 to 50°C), 20 to 90% R.H. Non Condensing
Temperature Indication Resolution	0.1° at <300°F and <300°C; 1° at >300°F and >300°C
Analog Output	0 to 1.0 Vdc linearized, temperature span adjustable
Digital Output	RS-232C, 4800 baud or selectable rate, 10 bit frame, no parity, 2 stop bits, 8 bit data. Protocol is selectable.
Digital Emissivity Adjustment	0.10 to 1.00 in 0.01 increments
Digital Response Time Constant	Adjustable 0 to 99 seconds, 1.0 second increments
Battery Life	Approx. 20 hours continuous, 4 AA Akaline batteries
Dimensions	5.31" x 6.89" x 2.36" (135mm x 175 mm x 60mm)
Weight	1.9 pounds (850 grams)

ULTIMAX™ PORTABLE IR THERMOMETER APPLICATIONS AND SELECTION TABLE

Model	Temperature Range (°F or °C)	Spectral Region (Microns)	Detector	Optical Resolution	Focus Distance	*Accuracy of Indicated Value or ±4°F (±2°C) whichever is greater	Repeatability Within (°F or °C)	Minimum Response Time	PRICE	PRIMARY APPLICATIONS
TUX-10	1655 to 5430°F 900 to 3000°C	0.65µ	Silicone	Focusable F = 250†	20" to ∞ ** 500 mm to ∞	<2700°F (1500°C) ±0.5% ±1 digit >2700°F (1500°C) ±1.0% ±1 digit >3600°F (2000°C) ±2.0% ±1 digit	2.0°F or 1.0°C	0.5 sec.	$ 2250.00	Incandescent applications for iron and steel, molten glass, and semiconductor processes
TUX-20	1115 to 5430°F 600 to 3000°C	0.96 to 1.05µ	Silicone	Focusable F = 100	20" to ∞** 500mm to ∞	<2700°F (1500°C) ±0.5% ±1 digit >2700°F (1500°C) ±1.0% ±1 digit >3600°F (2000°C) ±2.0% ±1 digit	2.0°F or 1.0°C	0.5 sec.	$ 2250.00	Steel mills, foundries, forging, induction heating, glass, and semiconductors
TUX-40	-50 to 1830°F -50 to 1000°C	8 to 13µ	Thermopile	Focusable F = 40	28" to ∞ 700mm to ∞	±1.0% ±1 digit	2.0°F or 1.0°C	1.0 sec.	$ 2550.00	General purpose low temperature including thick plastics, paper, food, textiles, inspection, agriculture and maintenance
TUX-41	-50 to 840°F -50 to 450°C	8 to 13µ	Thermopile	Fixed 0.16"@4" 4mm@100mm	See Table 1	±1.0% ±1 digit	2.0°F or 1.0°C	1.0 sec.	$ 2700.00	
TUX-42	-50 to 840°F -50 to 450°C	8 to 13µ	Thermopile	Fixed 0.32"@8" 8mm@200mm	See Table 1	±1.0% ±1 digit	2.0°F or 1.0°C	1.0 sec.	$ 2700.00	
TUX-50	755 to 2370°F 400 to 1300°C	3.7 to 4.0µ	Thermopile	Focusable F = 40	28" to ∞ 700mm to ∞	±1.0% ±1 digit	2.0°F or 1.0°C	2.0 sec.	$ 2550.00	Furnace and kiln maintenance applications such as shell or refractory temperatures
TUX-70	575 to 2370°F 300 to 1300°C	4.8 to 5.2µ	Thermopile	Focusable F = 40	28" to ∞ 700mm to ∞	±1.0% ±1 digit	2.0°F or 1.0°C	2.0 sec.	$ 3100.00	Refractory and ceramic production including glass, bricks, porcelain and quartz
TUX-71	935 to 5070°F 500 to 2800°C	4.8 to 5.2µ	Thermopile	Focusable F = 40	28" to ∞ 700mm to ∞	<2700°F (1500°C) ±1.0% ±1 digit >2700°F (1500°C) ±3.0% ±1 digit	4.0°F or 2.0°C	2.0 sec.	$ 3300.00	
TUX-80	305 to 750°F 150 to 400°C	7.5 to 8.5µ	Thermopile	Focusable F = 40	28" to ∞ 700mm to ∞	±1.0% ±1 digit	2.0°F or 1.0°C	2.0 sec.	$ 3300.00	Ideal for plastic, plastic film and low temperature glass applications
TUX-81	125 to 750°F 50 to 400°C	7.5 to 8.5µ	Thermopile	Fixed 1.58"@40" 40mm@1000mm	See Note (Table 1)	±1.0% ±1 digit	2.0°F or 1.0°C	2.0 sec.	$ 2550.00	

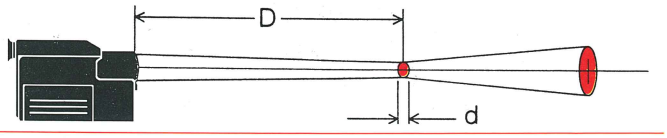
*Instrument @ 73°F ±9°F (23°C ±5°C), R.H. 35 to 75%; emissivity of 1.0 at blackbody reference.

**Optional close focus lens available.

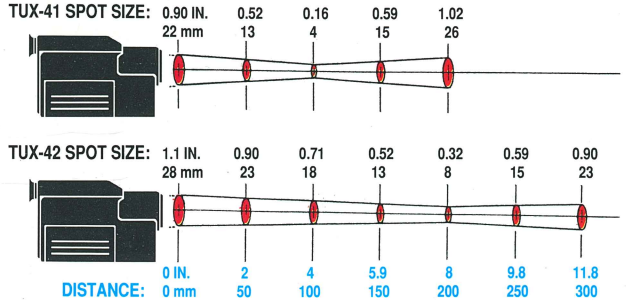
†Model TUX-10 using close focus lens. optical resolution changes as follows: TUX-CL1, F = 250; TUX-CL2, F = 230; TUX-CL3, F = 225; TUX-CL4, F = 200

Table 1 — Optical Resolution Distances and Spot Size Calculations

GENERALIZED RESOLUTION FORMULA Spot Size Formula: $d = \frac{D}{F}$ Where: d = Dia of cone at Focal Point, D = Distance from Ultimax to Focal Point, F = Resolution Factor of specific Ultimax model.



Optical Resolution for Models TUX-41 and TUX-42



NOTE: Optical resolution for Fixed Focus Model TUX-81 is 1.58" spot size at 40" or 40 mm at 1000 mm.

Truly portable Ultimax Datalogger/Printer connects to Ultimax thermometers and to computers with RS-232C port. The versatile TUX-PLP is *programmable* for wide variety of data collection, storage and data selection printing formats. The datalogger section is detachable from the printer and can store 1000 temperature readings. **Model TUX-PLP Datalogger/Printer, $900.00.** Cable included.

telatemp *TOLL FREE HOTLINE: 1-800-321-5160 EXCEPT CA: (714) 879-2901 TELEFAX: (714) 870-8136*
Telatemp Corporation P.O. Box 5160 Fullerton, CA 92635-0160

Prices and specifications subject to change without notice. Prices F.O.B. Fullerton, CA

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telatemp CWSI Data Logger

A Powerful, Yet Inexpensive System for CWSI Data Acquisition and Analysis

DATA LOGGER SPECIFICATIONS

Number of Channels	4 (Channels 1, 2 and 3 are analog and digital inputs; channel 4 is analog input only). 1 manual event marker activated via enter key during recording session.
Input Sensors	A library of sensor characteristics is defined in memory to support various analog and digital sensors.
Input Sampling Rate	650 ms.
Input Connectors	4 (6-pin gold plated phosphor bronze)
Input Impedance	1 x 10^{12} ohms
Resolution	0.1%
Excitation Voltage	3 VDC available on input connectors for use with active sensors.
Real Time Clock	Operator programmable. Display is in days, hours, minutes, seconds.
Recording Time	Programmable from 1 min. to 100 days.
Display	8 character alphanumeric LCD display functions include: analog inputs (as a meter), time, remaining memory capacity, battery voltage, sensor definition and calibration points.
Programming	Menu driven via 2 keys on front panel to select options and enter the parameters. Selection includes: sensor definition, calibration, channel selection, record time, real time, data display, record data, erase data, event mark and playback rate.
Output	RS-232C with programmable baud rates of 300, 1200, 4800, and 9600.
Power	4.5 VDC via 3 AA size rechargeable Ni-Cad batteries. Operation time between recharging depends on the number of active channels. Optional rechargeable battery pack allows >30 day use; operation off optional line powered recharger allows indefinite use.
Environmental	Operating temperature −10° to +60°C. Storage temperature −20° to +70°C. Relative Humidity 10% to 90% non-condensing.
Dimensions	145mm long x 80mm wide x 30mm
Weight	260g.
Software	Application software included to upload raw data to IBM PC or compatible. Allows for display and analysis of data and hard copy printout.

COMPUTER SYSTEM

Requirements	IBM PC or compatible computer with two double-sided double density disk drives, 256K or more, DOS 2.02 or greater; Hercules Graphics, CGA or EGA.

ORDERING INFORMATION

TELATEMP IR SENSORS

Model AG42. Measures canopy temperature and automatic air/target differential temperature. Range −30°C to 100°C with 0.1°C digital resolution. Accuracy ±0.5°C, repeatability 0.2°C	$3150.00
Model 43. Measures canopy temperature. Range 0° to 100°C with 0.1°C digital resolution. Accuracy ±0.5°C, repeatability 0.2°C	$2995.00

DATA LOGGER

Model RR400. Including basic application software	$ 495.00
Battery Charger RR-120	27.00
30 Day Rechargeable Battery Pack RR-130	80.00
Serial Computer Interface Cable (4′ long), RR-101M (male) and RR-101F (female), price each	35.00

ACCESSORIES

Wall Mount Plate, RR-200	$ 50.00
Tamperproof Enclosure, RR-205	108.00
Weatherproof Enclosure, RR-210	170.00
Input Connector Kit, Pkg. of 10. RR-100	18.00
IR Thermometer Adapter Cord (Connects Model 43, 44 or AG42 to pod)	50.00

SIGNAL CONDITIONING PODS

(For IR, Ambient Air, Humidity, Solar Radiation)

DC VOLTS		THERMISTOR PODS	
POD-12 0-100mv	$108.00	POD-02 −50° TO +150°C	
POD-13 0-2VDC	57.00	(10,000Ω @ 25°C, YSI 44016)	57.00
POD-12B ±100mv	135.00	POD-03 −40° TO +100°C	
POD-13B ±1VDC	135.00	(2,252Ω @ 25°C, YSI 44004)	57.00
DC CURRENT		**Additional Pods Available for RTD's, Thermocouples, Pulse Count, Event Recording and MPH**	
POD-10 4-20ma	57.00		
POD-11 0-100ma	57.00		

OPERATOR PROGRAMMING. RR400 operator programming includes sensor type, recording time (from minutes to 100 days), calibration, real time (including date), recording start, playback, and channel display. The 8-character LCD display prompts the operator with system set-up using a simple two key sequence. Real time readout of acquired data can be displayed and manually event marked.

APPLICATION SOFTWARE. The RR400 IBM® PC application software is a flexible, easy-to-use menu driven program to review, analyze and store, and to report data with hard copy printout. The X-Y axis annotation and graduations are defined by the data logger and transmitted to the computer. The application software allows the operator to redefine amplitude scales, engineering units, etc.

The program plots data, plots min/max or average, combines up to 9 plots and annotates plots with text messages. Also cumulative plots and histograms, alphanumeric data logging, listing of filed data. Prepares files for standard data base and spreadsheet programs.

PORTABLE INFRARED THERMOMETERS

TELATEMP BATTERY-OPERATED INFRARED THERMOMETERS are used worldwide to measure plant canopy/leaf temperatures with 0.5°C accuracy and 0.1°C resolution. Economical Model 43 has a range of 0° to 100°C. Model AG42 has a lower range of −30° to 100°C and the added ability to automatically measure the minute differential temperature between crop canopy and ambient air.

telatemp **Toll Free Hotline* 1-800-321-5160**

*Except California Call (714) 879-2901

Telatemp Corporation/P.O. Box 5160/Fullerton, CA 92635-0160

Prices and specifications subject to change without notice. Prices F.O.B. Fullerton, CA.

telatemp CWSI Data Logger

CATALOG #RR400

IBM PC®-Based Infrared Temperature Data Logger Increases Crop Yields by Monitoring CWSI Parameters

TELATEMP CWSI DATA LOGGER SYSTEM consists of portable, high accuracy and economical field instrumentation and software to measure, record and later computer analyze the primary environmental factors that contribute to the Crop Water Stress Index. System includes RR400 4-channel data logger with supplied application software, signal conditioning pods for sensors, and Models 43 or AG42 infrared thermometer to measure crop canopy.

- **Portable system simultaneously records plant canopy temperature, solar radiation, relative humidity and air temperature**
- **Proven Telatemp IR thermometer precisely measures plant canopy/leaf temperatures**
- **Data logger uploads environmental data collected in field to IBM PC or compatible computer**
- **Menu driven software allows data to be reviewed, analyzed, plotted and printed**

The new state-of-the-art Telatemp IBM PC-based CWSI portable data logger system consists of high accuracy, yet economical, field instrumentation and application software to simultaneously measure, record and later computer analyze the primary environmental factors that contribute to the Crop Water Stress Index.

CWSI MEASUREMENTS. Critical CWSI measurements and recordings can be made from a few minutes to several hours or days. The Telatemp data logger system allows the researcher and farm manager to accurately and economically collect all the data necessary to fit into user defined CWSI curves.

Telatemp's easy-to-use application software provides the user with a powerful, yet flexible, tool to analyze stress factors and review data to optimize irrigation levels for improved crop yields.

The charts below illustrate two typical examples of CWSI plots over time. Figure 1 defines the relationship of a CWSI curve throughout a growing season as water is applied at critical times. Figure 2 shows the relationship of the CWSI against available soil water.

TELATEMP SYSTEM. The system includes a Telatemp rechargeable battery-operated Model RR400 4-channel data logger, which stores one channel of data from a Telatemp portable infrared thermometer to precisely record crop canopy temperature, plus three additional channels to record solar radiation, relative humidity and air temperature.

A selection of signal conditioning pods conveniently mates with the user's data acquisition sensors. Telatemp's powerful menu driven application software, which is supplied with the RR400, allows acquired data to be simply reviewed, analyzed, plotted and printed. Data transmission from the data logger to the PC is through a built-in RS-232C port.

TYPICAL EXAMPLES — CROP WATER STRESS INDEX AS A FUNCTION OF TIME

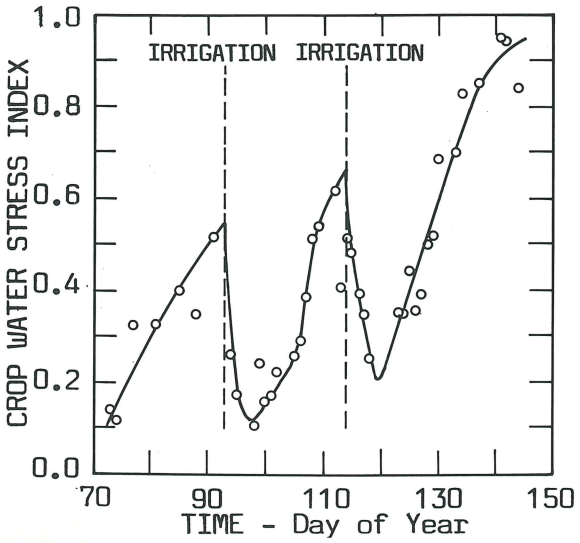


FIGURE 1.

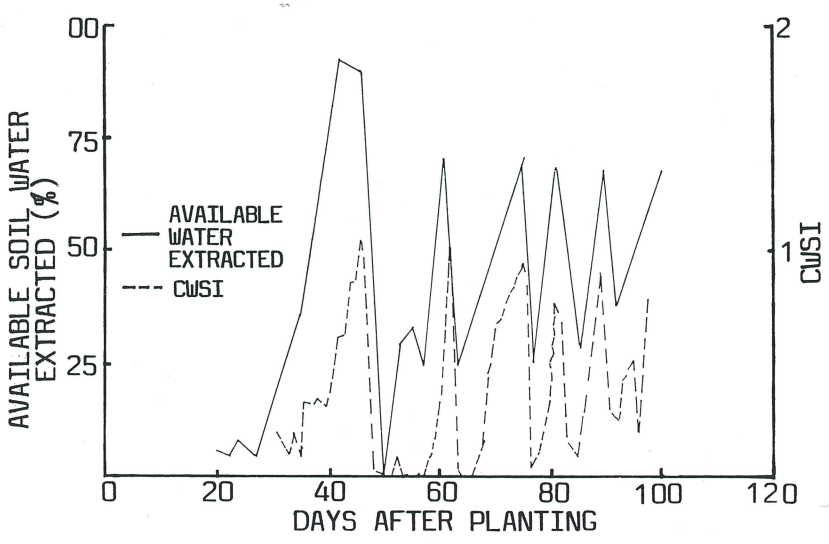


FIGURE 2.

telatemp Infrared Thermometers

Measure Surface Temperatures Precisely, Without Contact

Telatemp portable infrared thermometers instantly and conveniently measure, without contact, the surface temperature of most materials...including steel, plastics, cement, glass, food, pulp and paper, granular processes, plant life, and electronic components.

Non-Contact vs. Contact Measurements. Telatemp hand-held infrared thermometers have many advantages over contact thermometers for high accuracy measurements. By measuring the amount of infrared energy emitted from a solid object, an instrument can display a temperature readout in less than one second without touching the target being measured.

Simple Operation. In practice the operator simply aims the Telatemp instrument at the target to be measured for an instant digital readout.

Which Instrument for Your Application? For general purpose measurements, Model 44L with a switchable range of 0° to 1000°F and 0° to 600°C and 1° LED resolution is popular. A "Hot Spot" indicator brightens proportionally during scanning.

For laboratory measurements, Model 43L has 0.1°C LED resolution from 0° to 100°C.

For targets as small as 4 mm and low mass electronic components and biological materials select Model 44SM4.

For 0.1°C resolution agricultural and environmental research with automatic ambient air/target differential measurements from −30° to +100°C, Model AG42 is a proven instrument.

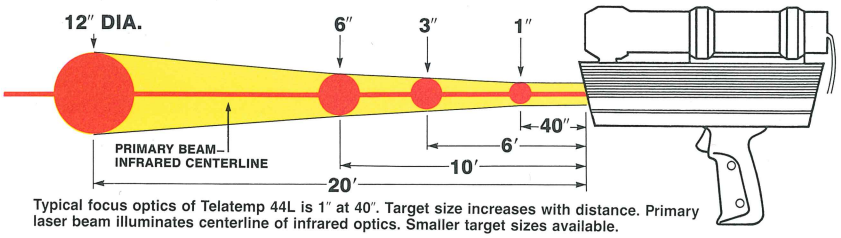
For troubleshooting PC board components and other low mass surfaces, laser-sighted Model 44LE will visually (with bright red laser beams) identify and measure a target as small as 8 mm (0.3") with 1°C resolution.

Sighting the Target. Four sighting methods are shown below. Most common is **Sightline,** which aims like a gun across the top of the instrument. Models 43S and 44S **Telescopic** sighting have a parallax-free scope showing a bright magnified image of the target. The **Apex Cone** method uses the tip of the cone to define a small target.

New Laser/Rangefinder Sighting. Because the temperature measurement displayed is an average of the entire target size focused on by the infrared optics of the instrument, and this target size increases with distance, the technique of aiming at the target for extremely precise measurements can be significant.

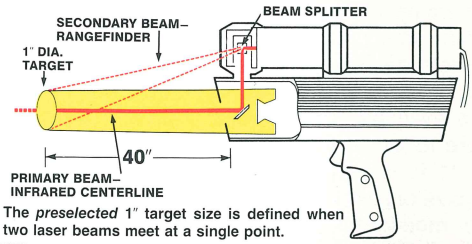
With Telatemp patented dual-laser sighting, a visible bright red primary beam illuminates the infrared centerline of the target being measured. A secondary laser beam acts as a rangefinder. When the two red laser beams meet at a single point, the preselected target size is identified (as small as 8 mm dia.).

TARGET SIZE VS. DISTANCE



Typical focus optics of Telatemp 44L is 1" at 40". Target size increases with distance. Primary laser beam illuminates centerline of infrared optics. Smaller target sizes available.

LASER FOCAL DISTANCE RANGEFINDER



The *preselected* 1" target size is defined when two laser beams meet at a single point.

SIGHTING METHODS:

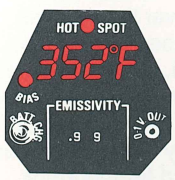
TELATEMP PORTABLE IR THERMOMETERS

MODEL	44	44LE	43	44/SM4	AG42
APPLICATIONS	General Purpose, Industrial, Digital Readout & Analog "Hot Spot"	Small 8 mm laser-sighted target. PC boards, low mass surfaces.	Low Temp 0.1°C resolution. Lab Use, Earth Sciences	Small 4 mm target for biological and electronics	Agricultural research. Automatic air/target differential temperature
SIGHTING	44 (Sightline) 44S (Telescopic) 44L (Laser/ Rangefinder)	Laser/Rangefinder	43 (Sightline) 43S (Telescopic) 43L (Laser/ Rangefinder)	Cone Apex	Sightline
TEMPERATURE RANGE	0° to 1000°F and 0° to 600°C, switchable	0° to 1000°F and 0° to 600°C, switchable	0° to 100°C	0° to 500°F and 0° to 260°C, switchable	–30°C to 100°C
RESPONSE TIME	<1 Second	<1 Second	1 Second	<1 Second	1 Second
RESOLUTION	1°F or 1°C	1°F or 1°C	0.1°C	1°F or 1°C	0.1°C
TARGET SIZE @ FOCAL POINT	1" @ 40" D/40 @ other Optional Distances	8 mm @ 0.3 m (0.3" @ 12")	4° Cone @ Infinity Optional 2" square @ 40"	4 mm @ Cone Apex	4° Cone @ Infinity
PRACTICAL WORKING DISTANCE	1" to 40 feet	12" w/Laser Rangefinder; 1" to 10 feet w/Laser Centerline	1" to 40 feet	0.1" to 0.4"	1" to infinity
DIGITAL READOUT	0.43" LED	0.43" LED	0.43" LED (LCD option)	0.43" LED	0.43" LED (LCD option)
ACCURACY	±0.5% FS	±0.5% FS	±0.5°C	±1% FS	±0.5°C
REPEATABILITY	±0.5% FS	±0.5% FS	±0.2°C	±2°F	±0.2°C
POWER SOURCE	Rechargeable Nickel-Cadmium Batteries and 120/240 VAC Charger				
PRICE	44 $1795 44S $2085 44L $2795	44LE $2895	43 $2995 43S $3300 43L $3995	44/SM4 $2750	AG42 $3150

Prices include carrying case and battery recharger.

TELATEMP IR THERMOMETERS ACCURATELY MEASURE:

- **Machinery in operation,** without interfering with production, such as gear drives, bearings, die faces
- **Continuously moving materials** requiring a quick measurement, including coatings, textiles, paper, and plastics
- **Inaccessible targets** at a distance such as steam traps, piping, and insulation
- **Uneven and rough surfaces,** including granular materials, where an average reading of the target is displayed
- **Dangerous high voltage components** in electrically hot areas, such as power plants
- **Low mass and small materials,** where contact measurement methods would change the measured condition...such as electronic components and biological specimens.



Model 44 combination analog "Hot Spot" and digital readout.

telatemp Process Control Systems

Fixed infrared sensing head shown with optional laser mounted on top for precise bright red visual laser sighting of center of target being measured.

Model 2100 Infrared Three-Mode System

The 2100 combines a Telatemp fixed head infrared thermometer with a microprocessor-based digital three-mode controller to control process temperatures in the range of 0°F to 1000°F or 0°C to 600°C. It is ideally suited to applications which require maintaining the temperature of moving targets, such as a production line, traveling curing molds for polyurethane products, flowing melts, moving billets, and paper webs. Once installed all adjustments are made at the controller, which features:

- The process and the setpoint temperatures are displayed simultaneously on 0.3 high LED readouts.
- Readings are in either °F or °C by use of an internal switch.
- Heat/cool proportional output with any combination of relay, 4-20mAdc, triac or 24Vdc pulsed output for solid state relays.
- Internal alarms may be programmed to operate as either a process or deviation alarm and to energize or de-energize on alarm.
- Control parameters programmed with four membrane switches on the front panel.
- Internal lockout switch prevents adjusting all settings except setpoint.
- Nonvolatile memory retains settings when power is off, without backup batteries.
- Front panel indicators show output and alarm conditions.

Hand-Held Infrared Temperature Data Logger with IBM® Compatible Application Software

The battery-operated, rugged Model RR400 portable infrared temperature data logger stores one channel of data from a Telatemp portable or fixed head infrared thermometer, plus three additional channels with optional signal conditioning pods for DC volts, AC volts, current, RPM, pulse count, thermistors, thermocouples, MPH, event marking, etc. RR400 acquires up to 100 days of data anywhere in the factory or field for later powerful computer review, analysis and reporting.

DATA OUTPUT. Data review and analysis are provided by a flexible application package for the IBM® PC and compatibles. Data transmission to the computer is sent using the RR400 built-in RS-232C port.

OPERATOR PROGRAMMING. RR400 operator programming includes sensor type, recording time (from minutes to 100 days), calibration, real time (including date), recording start, playback, and channel display. The 8-character LCD display prompts the operator with system set-up using a simple two key sequence. Real-time readout of acquired data can be displayed and manually event marked.

FACTORY APPLICATIONS: For process control troubleshooting, electrical power monitoring, plant maintenance, event recording and HVAC audits.

ENVIRONMENTAL APPLICATIONS: With optional waterproof RR400 housing and weatherproof Model 50 infrared thermometer, ideal for outdoor environments

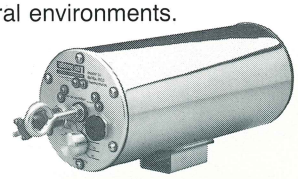
such as lake water analysis, sewage treatment analysis, and geological surveying.

AGRICULTURAL APPLICATIONS: Telatemp AG42 infrared thermometer and the RR400 will record crop canopy temperature. When combined with other parameters such as humidity, ambient air, solar radiation, etc., it will provide computerized CWSI data to improve crop yields. Model 50 infrared thermometer measures large areas for agricultural evapotranspiration studies.

APPLICATION SOFTWARE. The RR400 IBM® PC application software is a flexible, easy-to-use menu driven program to review, analyze and store, and to report data with hard copy printout. The X-Y axis annotation and graduations are defined by the data logger and transmitted to the computer. The application software allows the operator to redefine amplitude scales, engineering units, etc. The program plots data, plots min/max or average, combines up to 9 plots and annotates plots with text messages. Also cumulative plots and histograms, alphanumeric data logging, listing of filed data. Prepares files for standard data base programs.

Large Area IR Thermometer

The Model 50 infrared thermometer was designed for continuous year-round operation in the conditions encountered in agricultural environments.



Its heavy duty stainless steel housing is weatherproof and is resistant to pesticide sprays and other agricultural materials. The standard 50° field-of-view provides temperature measurement capability over large areas. Other optional viewing angles may be specified. The primary application for the Model 50 is in agricultural evapotranspiration studies; however, its use is equally valuable for measuring temperatures over any large area where temperature changes are of critical importance. Range of 0° to 100°C, accuracy ±0.5°C.

telatemp corp

Toll Free Hotline* 1-800-321-5160 *Except California Call (714) 879-2901

Telatemp Corporation P.O. Box 5160/Fullerton, CA 92635-0160

Prices and specifications subject to change without notice. Prices F.O.B. Fullerton, CA.

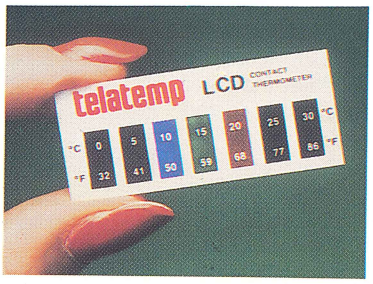
telatemp

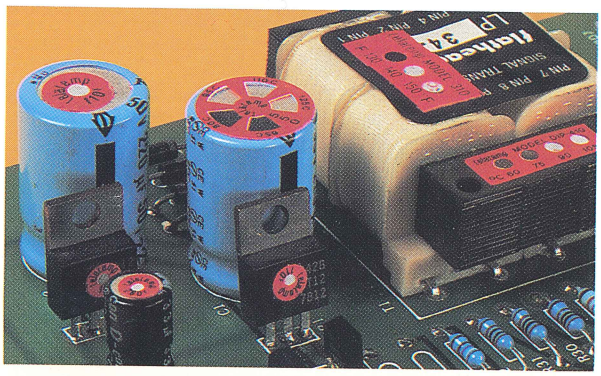
CATALOG #995
Revision A

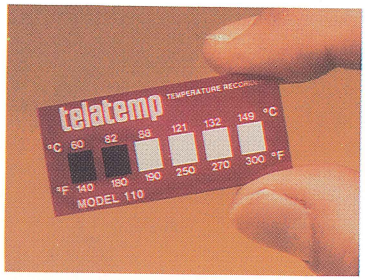
Precision Temperature Measurement Instruments

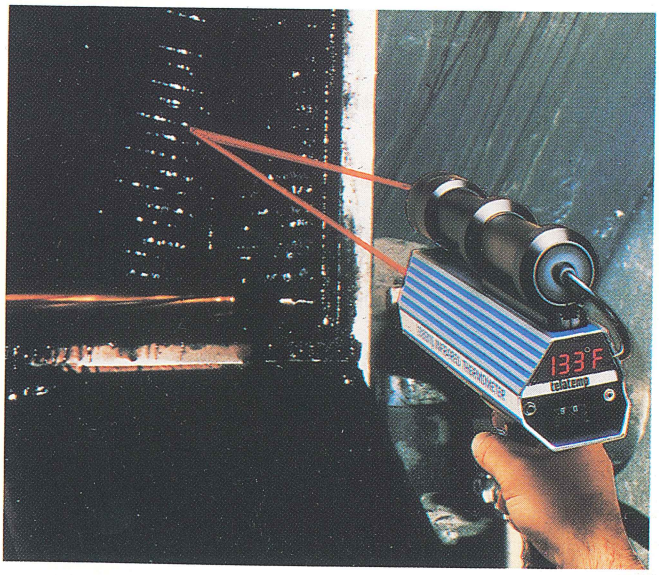
Non-reversible and Reversible Temperature Recording Labels • Portable Infrared Thermometers
Time/Temperature Thermometers • Freeze Temperature Indicators • Infrared Temperature Control Systems

Plant Engineering, Maintenance, Processing, Quality Control, Energy Conservation, Manufacturing, R & D, Environmental Agriculture and Research









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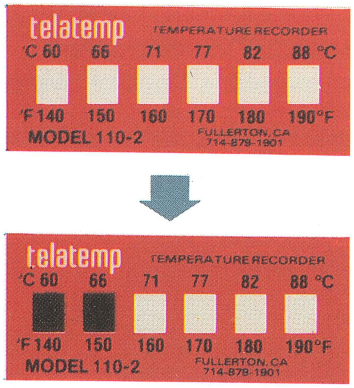
Toll Free Hotline* 1-800-321-5160 *Except California Call (714) 879-2901

Telatemp Corporation P.O. Box 5160/Fullerton, CA 92635-0160

telatemp Non-Reversible Temperature Recorders

Calibrated Indicators Turn Black at Rated Temperatures



#110 1.75″ × .75″

General Purpose, 6-position Wide-Range Recorders

MODEL 110 contains six temperature sensing increments covering a range of 50°F on a single model configuration. This enables the user to bracket overheat measuring requirements. Using several Model 110's, with overlapping values, extends this range simply and economically. Rated values are printed at the indicator windows in both °F and °C. High temperature models are white, with gold indicators, due to material requirements.

Ordering Information for Model 110: Consult STANDARD RANGE SELECTION TABLE. Order any of the configuration Nos. 1 through 9 (each of which includes six increments covering both Ranges A and B); i.e., specify Model 110-4 for 220°F through 270°F and 104°C through 132°C. Special configurations and temperature arrangements are available; please consult factory.

MODEL 110 – PRICES

QUANTITY	Configurations 1 thru 6	Configurations 7 thru 9
20–99 pcs	$1.50 ea.	$2.00 ea.
100–499 pcs	1.25 ea.	1.85 ea.
500–999 pcs	1.15 ea.	1.55 ea.

MODELS 310 & 330 – PRICES

QUANTITY	Configurations 1 thru 6 (A or B)	Configurations 7 thru 9 (A or B)
20–99 pcs	$1.25 ea.	$1.95 ea.
100–499 pcs	1.15 ea.	1.75 ea.
500–999 pcs	1.05 ea.	1.45 ea.

Miniature, self-adhesive indicators permanently record overheat

Telatemp non-reversible temperature recording labels economically sense and record surface temperatures. Each recorder contains one or more sealed temperature sensitive indicators which turn permanently and irreversibly from silver to black at its calibrated rated temperature.

Response time is less than one second with an accuracy of ±1%. Rated temperatures are printed in both °F and °C at each indicator window, and the direct readout can be viewed at a glance.

The miniature size and thickness (nominal 0.01″) of these labels allow installation in areas and on parts which are not practical for other instruments.

The exposed Telatemp temperature labels may be removed for test reports or filed for subsequent reference. The recorders will withstand thermal cycling, solvents and water, and can be stored indefinitely.

Compare Telatemp's low price and high quality. Telatemp invites requests for special designs and custom configurations.

Standard Range Selection Table

Standard Configuration No.		MODEL 110 RANGE A (Models 310 & 330)			MODEL 110 RANGE B (Models 310 & 330)		
1	°F	100	110	120	130	140	150
	°C	38	43	49	54	60	66
2	°F	140	150	160	170	180	190
	°C	60	66	71	77	82	88
3	°F	180	190	200	210	220	230
	°C	82	88	93	99	104	110
4	°F	220	230	240	250	260	270
	°C	104	110	116	121	127	132
5	°F	260	270	280	290	300	310
	°C	127	132	138	143	149	154
6	°F	300	310	320	330	340	350
	°C	149	154	160	166	171	177

HIGH TEMPERATURE CONFIGURATIONS

7	°F	350	360	370	380	390	400
	°C	177	182	188	193	199	204
8	°F	390	400	410	420	435	450
	°C	199	204	210	216	224	232
9	°F	435	450	465	480	490	500
	°C	224	232	241	249	254	260

MINIMUM ORDER: 20 pieces of any model/configuration number. Different model/configuration numbers may not be combined for quantity price breaks or to make up a minimum order. Delivery from stock.

Miniature and Electronic Component Recorders

#DIP-410 .75″ × .25″

MODEL DIP-410 was specifically designed for dual-in-line packages. Contains four temperature indicators: 60°C, 75°C, 90°C, and 105°C. Other temperatures available on special order; consult factory.

550 .58″ Dia.

MODEL 550 was designated to measure the operating temperature of TO-3, TO-66 and 42-lead LSI flatpacks. Contains five temperature indicators: 65°C, 80°C, 95°C, 110°C, and 125°C. Consult factory for special requirements.

#505 .320″ Dia.

MODEL 505, designed for small semiconductor power packages, covers five increments: 65°C, 80°C, 95°C, 110°C, 125°C. Telatemp 505 covers upper end range for most power transistors, including TO-5, TO-99, TO-100, and TO-91. Consult factory for special requirements.

HOT SPOT .19″ Dia.

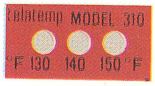
HOT SPOT contains a single tiny temperature indicator. Ideal for small and low mass components, for hard to reach locations, and for "tattletale" warranty protection. Available as a standard model in °F only in any single increment from 100°F to 350°F. Choose temperatures from STANDARD RANGE SELECTION TABLE. Higher temperatures and °C available on special order; please consult factory.

MINIATURE RECORDERS – PRICES

QUANTITY	Models DIP-410, 505 & 550	Hot Spot 100°F-350°F
20–99 pcs	$1.50 ea.	$.95 ea.
100–499 pcs	1.25 ea.	.85 ea.
500–999 pcs	1.15 ea.	.75 ea.

MINIMUM ORDER: 20 pcs. of any model number. Different model numbers may not be combined for quantity price breaks or to make-up a minimum order. Delivery from stock.

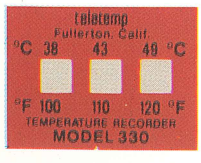
General Purpose, 3-Position Recorders



#310 .75″ × .38″

MODEL 310 features a compact size, with three sensing elements covering a 20°F range. Standard models read in °F only.

Ordering Information for Model 310: Consult STANDARD RANGE SELECTION TABLE. Order any configuration Nos. 1 through 9. Specify Range A or B (three increments); i.e., Model 310-1-B for 130°F through 150°F. Special configurations are available; please consult factory.



#330 1″ × .75″

MODEL 330 is a medium-size recorder that contains three temperature sensing increments covering a 20°F range on a single configuration. Rated values are printed in both °F and °C at the indicator windows.

Ordering information for Model 330: Consult STANDARD RANGE SELECTION TABLE. Order any configuration Nos. 1 through 9. Specify Range A or B (three increments); i.e., Model 330-1-A for 100°F through 120°F and 38°C through 49°C. Special configurations are available; please consult factory.

Special Assortment Kits

Part No.	Description	Assortment Price
LTA-1	Low Temperature (15 Each Model 110-1, -2, -3, -4, -5, -6)	$120.00
HTA-1	High Temperature (15 each Model 110-7, -8, -9)	85.00
CTA-1	Combination High/Low Temperature (15 each Model 110-1, -2, -3, -4, -5, -6, -7, -8, -9)	200.00

DELIVERY: Stock

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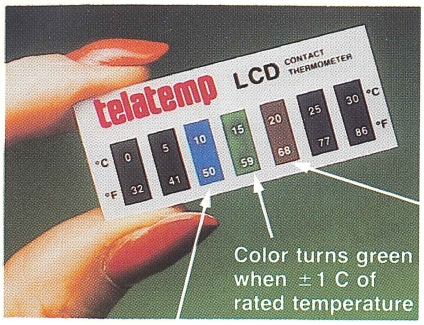
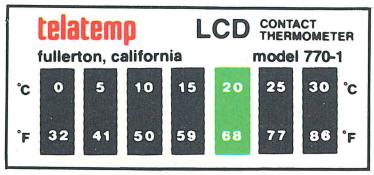
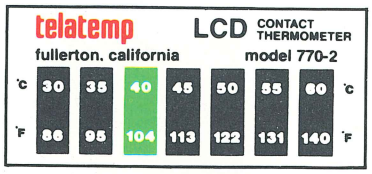
telatemp LCD Reversible Temperature Indicators


telatemp LCD CONTACT THERMOMETER
°C 0 5 10 15 20 25 30 °C
°F 32 41 50 59 68 77 86 °F
Color turns brown when slightly below rated temperature
Color turns green when ±1 C of rated temperature
Color turns blue when slightly above rated temperature

For Processing, Q.A. and Test



#770-1 1.75″ × .75″
Ranges: Both 0° to 30°C and 32° to 86°F in 5°C increments



#770-2 1.75″ × .75″
Ranges: Both 30°C to 60°C and 86°F to 140°F in 5°C increments

For Electronic Design and Test

#880 .75″ × .25″
Ranges: 45°C to 60°C in 5°C increments

#660 .56″ Dia.
Ranges: 40°C to 60°C in 5°C increments

For accurate, continuous visual monitoring of surface temperatures

Telatemp LCD reversible, miniature self-adhesive labels are designed to be read at a glance to indicate: (1) overheating, (2) the effects of both high and low temperatures, and (3) that equipment, parts, machinery or other surfaces are too hot to handle. Even slight changes are detectable, and readings within one or two degrees are easily visually observed during test and quality control.

Reversibility allows the user to repeat tests and to monitor recurring events. Telatemp LCD contact thermometers are unharmed by exposure to body or ambient air temperatures. This feature, coupled with detection of temperatures to the freezing point, is useful for low-temperature applications. These devices are also ideal for monitoring temperatures of electronic components, PC boards and subassemblies.

MODELS 770-1, 770-2, 660, 880 ORDERING INFORMATION

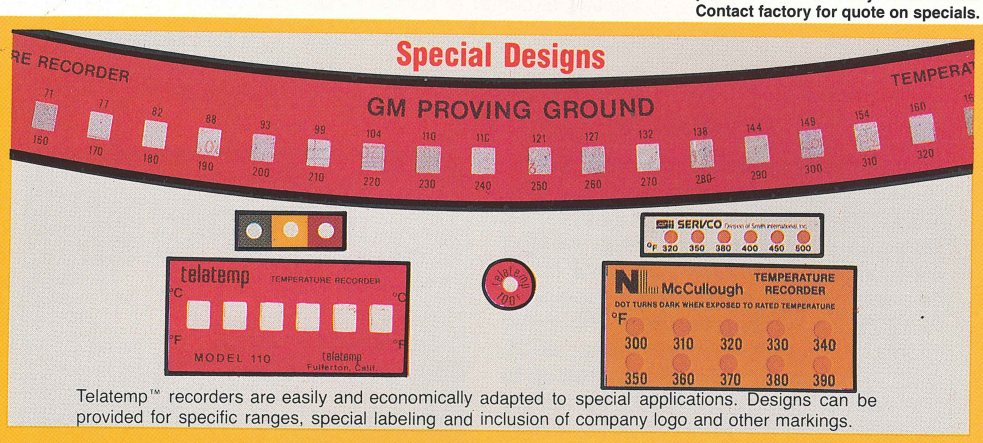
Quantity	Price
10–99 pcs	$4.00 ea.
100–499 pcs	3.25 ea.
500–999 pcs	2.75 ea.

MINIMUM ORDER: 10 pieces of any part number. Different model or dash numbers may not be combined for price breaks. Delivery from stock. Contact factory for quote on specials.

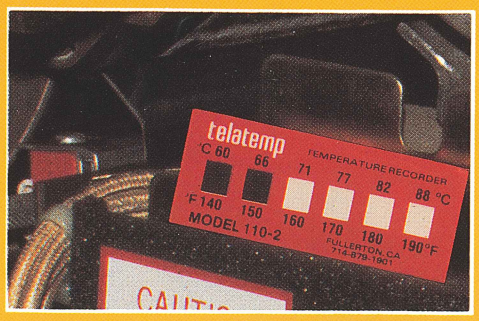
Typical Applications

- **Monitor and record temperatures** during baking, sealing, curing, welding
- **Check tool and material operations** of drills, grinders, cutters, meters, lathes
- **Monitor electronic components,** semiconductors, circuit boards, computers
- **Environmental testing** of instruments and aircraft and aerospace systems
- **Indicate electrical overheat** of bearings, transformers, motors, generators, rectifiers, relays
- **Storage and transport temperatures** of chemicals, food, pharmaceuticals

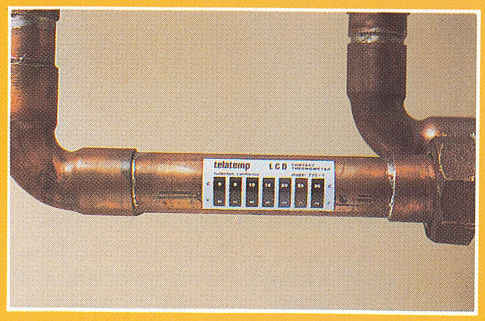
Special Designs



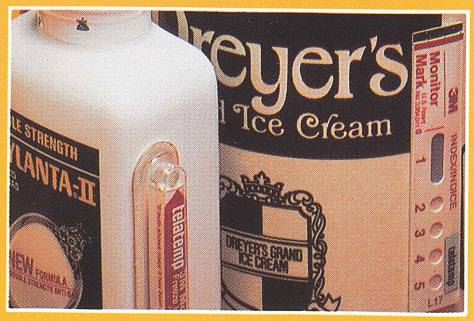
Telatemp™ recorders are easily and economically adapted to special applications. Designs can be provided for specific ranges, special labeling and inclusion of company logo and other markings.



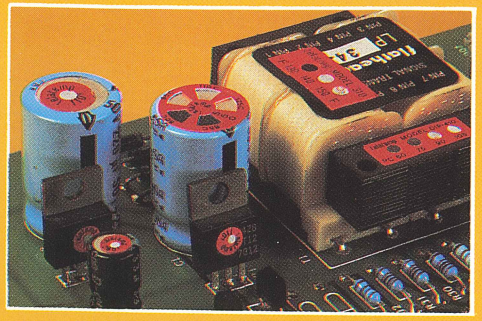
PREVENTATIVE MAINTENANCE of machinery and electrical equipment by detecting overheat with Model 110.



CONTINUOUS MONITORING of temperature with LCD Model 770 for quality control and test.



COLD TEMPERATURES. Freeze Indicator (left) protects pharmaceuticals. Telatemp Tag (right) monitors temperature over time.



ELECTRONIC DESIGN evaluated under load with miniature non-reversible temperature recorders.

HEAT DISSIPATION is studied with reversible LCD indicator designed for electronic applications.

QUALITY ASSURANCE of sensitive products are recorded with Time/Temp Button and Labels from 2°F to 133°F.

telatemp Time/Temp Indicators

Time/Temp Tags

Telatemp Time/Temp Tags were designed to monitor and record temperature exposure over time for quality control during storage or transit of refrigerated products. These self-adhesive devices provide a visual irreversible record of accumulated time/temperature exposure to products. Size, ¾″ × 3-¾″ × 1/16″ thick. Common applications are described in the table below.

TIME/TEMP TAGS

TYPICAL APPLICATIONS	PRODUCT #	RUN OUT TIME	DEGREE C.	DEGREE F.
Frozen Foods—Meats Fish—Vegetables Ice Cream	L17 I17 I12	7 days (168 hours) 48 hours 48 hours	−17 −17 −12	2 2 10
Meat—Pre-Plated Meals Bakery Products	L7 L1 I1	7 days (168 hours) 7 days (168 hours) 48 hours	−7 −1 −1	19 30 30
Refrigerated Products Produce—Prepared Foods	5L 5I	7 days (168 hours) 48 hours	5 5	41 41
Whole Blood—Red Cells Plasma—Vaccines Draft Beer	10L 10I	7 days (168 hours) 48 hours	10 10	50 50
Biologicals—Epoxy Prepregs Confectioneries	20L	7 days (168 hours)	20	68
Chocolate Candy Gelatin Capsule Products Graphic Arts Products	25I 31L	48 hours 7 days (168 hours)	25 31	77 88
Chemicals Diagnostics Medical Products	48L	7 days (168 hours)	48	118

TIME/TEMP TAGS ORDERING INFORMATION

QUANTITY	PRICE
15–49 PCS.	$2.75 ea.
50–99 pcs.	2.25 ea.
100–499 pcs.	1.50 ea.
1 to 4 cases (500 pcs./case)	1.35 ea.

MINIMUM ORDER: 15 pieces of any part number. Different models may not be combined for price breaks. Stock delivery up to 1000 pieces.

UNACTIVATED TAG

ACTIVATED TAG SHOWS BRIEF EXPOSURE TO TEMPERATURE

ACTIVATED TAG INDICATES ACCUMULATED EXPOSURE TIME

Freeze Indicators

Telatemp MonitorMark™ indicators tell when your product has been exposed to cold and freezing temperatures during storage or in transit. Three models are available that activate upon exposure to low temperatures of 26°F, 32°F or 41°F. To use, simply peel off self-adhesive backing and apply to package to be monitored. The liquid-filled glass tube indicator is housed in a 5/8″ × 3/16″ × 3/8″ high plastic housing. Product must be stored *above* its response point.

FREEZE INDICATORS ORDERING INFORMATION

Model	Response Temperature	PRICE PER PIECE 15-49 pcs.	50-99	100-499
A3	26°F (−3°C)	$3.75 ea.	$3.00 ea.	$2.10 ea.
OA	32°F (0°C)	3.75 ea.	3.00 ea.	2.10 ea.
A5	41°F (5°C)	3.75 ea.	3.00 ea.	2.10 ea.

MINIMUM ORDER: 15 pcs. of any model number. Different model numbers may not be combined for quantity price breaks or to make-up a minimum order.

UNEXPOSED glass indicator bulb is clear before exposure

AFTER EXPOSURE streaks of violet color appear. When temperature returns above rated temperature, liquid-filled bulb will remain a solid violet color.

Time/Temp Buttons

Telatemp Time/Temp Self-Adhesive Buttons are available to indicate a product's exposure over time to response temperatures from 2°F (−17°C) to 68°F (20°C). After five minutes of exposure, a spot of blue will begin to appear. Continual exposure of an hour or more will turn the entire center of the white button irreversibly and permanently blue. Accuracy ±1°C.

TIME TEMP BUTTON ORDERING INFORMATION

Model	Response Temperature	PRICE PER PIECE 15-49 pcs.	50-99	100-499
B17	2 F (−17 C)	$2.50 ea.	$1.75 ea.	$.95 ea.
5B	41 F (5 C)	2.50 ea.	1.75 ea.	.95 ea.
10B	50 F (10 C)	2.50 ea.	1.75 ea.	.95 ea.
20B	68 F (20 C)	2.50 ea.	1.75 ea.	.95 ea.

MINIMUM ORDER: 15 pcs. of any model number. Different model numbers may not be combined for quantity price breaks or to make-up a minimum order.

BEFORE ACTIVATION
Time/Temp Buttons are clear and white. Depress the center to activate.

EXPOSURE INDICATED
If surface exceeds the rated temperature, a blue spot begins to spread from center of button.

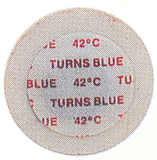
Time/Hi-Temp Labels

Low cost and reliable the Telatemp Time/Hi-Temp self-adhesive labels record a product's exposure to a rated temperature from 93°F (34°C) to 133°F (56°C) over time while in storage or transit. After five minutes of exposure to temperatures over the response time, a spot of blue will begin to appear at the center of the label. Continued exposure of an hour or more will irreversibly and permanently turn the center from white to blue. Accuracy of ±1°C. Must be stored below rated temperature.

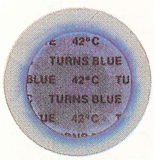
TIME/HI-TEMP LABEL ORDERING INFORMATION

Model	Response Temperature	PRICE PER PIECE 15-49 pcs.	50–99	100–499
34AA	93°F (34°C)	$.95 ea.	$.90 ea.	$.85 ea.
42AA	108°F (42°C)	.95 ea.	.90 ea.	.85 ea.
50AA	122°F (50°C)	.95 ea.	.90 ea.	.85 ea.
56AA	133°F (56°C)	.95 ea.	.90 ea.	.85 ea.

MINIMUM ORDER: 20 pcs. of any model number. Different model numbers may not be combined for quantity price breaks or to make-up a minimum order.



UNEXPOSED
Label is clear and white before exposure



AFTER EXPOSURE
Over response temperature a blue spot will begin to spread to center of label